

UNITED STATES DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE

CONSERVATION PRACTICE STANDARD

GRASSED WATERWAY
(Acre)

Code 412

DEFINITION

A natural or constructed channel that is shaped or graded to required dimensions and established in suitable vegetation for the stable conveyance of runoff.

PURPOSE

This practice may be applied as part of a conservation management system to support one or more of the following purposes:

- to convey runoff from terraces, diversions, or other water concentrations without causing erosion or flooding,
- to reduce gully erosion,
- to protect/improve water quality.

CONDITIONS WHERE PRACTICE APPLIES

All sites where added capacity, vegetative protection or both are required to control erosion resulting from concentrated runoff and where control can be achieved by the use of these practices alone or in combination with other conservation practices.

CRITERIA

General Criteria Applicable to All Purposes

Grassed waterways shall be planned, designed, and constructed to comply with all federal, state, and local laws and regulations.

Capacity

The minimum capacity shall be that required to confine the peak runoff expected from a 10-year frequency, 24-hour duration. When slope is less than 1 percent, out-of-bank flow may be permitted if such flow will not cause excessive erosion. The minimum capacity, in such cases, shall be the capacity required to remove the water before crops are damaged.

Velocity. Design velocities shall not exceed those obtained by using the procedures, "n" values, and recommendations in the NRCS Engineering Field Handbook (EFH) Part 650, Chapter 7, or Agricultural Research Service (ARS) Agricultural Handbook 667, Stability Design of Grass-lined Open Channels. Exhibit 7-3, Alabama Engineering Field (Design) Manual, may be used to determine rock size for stoned centered waterways.

Either stone center, lined waterway sections, or underground outlets will be used where needed, especially on easily eroded soils. Minimum capacity of lined sections should be the peak rate of runoff from the 1-year, 24-hour storm. The capacity of the waterway or outlet will be computed from the formula $Q=AV$, where Q is the volume rate of flow, A is the cross-sectional area, and V is the velocity. A stable velocity will be calculated from Manning's formula:

$$V = \frac{1.486}{N} R^{2/3} S^{1/2}$$

Design velocities shall be based on:

- (1) the erodibility of the soil,
- (2) conditions under which vegetative cover is established,

- (3) the type and height of vegetation used, and
- (4) the probability of obtaining a good cover in a short length of time.

A stable waterway outlet will be established prior to the construction of terrace, diversion, or water and sediment control basin.

Deep sands and other soils in hydrologic group A or B rated as "too sandy." The water management system will have either (1) stable grassed waterways, vegetated disposal areas of filter strips established before the terrace systems are constructed or (2) underground outlets will be installed concurrently.

Soils in hydrologic group A or B not rated as "too sandy" and soils in hydrologic group C or D.

Grassed waterways and disposal areas may be installed concurrently with the water management system if either the drainage area is so small or the slope is so gentle that vegetation can establish without rill or gully erosion occurring as the vegetation becomes established. This condition will be determined by good judgment after considering the sites' erodibility, slope, and drainage area.

If favorable conditions do not exist for concurrent installation of the system and establishment of vegetation, then either (1) grassed waterways or disposal areas will be established before the system is constructed or (2) underground outlets will be installed concurrently with the system. On some sites, it is feasible to use end closure terraces or diversions with pipes for dewatering during installation of the system on erosion resistant soils before vegetation is established in the waterway or disposal area. This method requires some storage of runoff that may damage the crop being grown.

Design velocities shall not exceed the permissible velocities corresponding to the cover, slope range, and site conditions as indicated in the Alabama Engineering Field (Design) Manual. Under normal conditions where vegetation is to be established by seeding, maximum design velocity (V_1) will not exceed 4 (1.2 m/s) feet per second on clay soils (erosion resistant) and 3 (0.9 m/s) feet per second on sandy soils (easily eroded).

Shape

Waterways and outlets shall be either parabolic or trapezoidal in cross section. Where natural

draws are not available and where runoff makes it impractical to either construct a waterway or establish the vegetation, water will be discharged over a broad, wedge-shaped disposal area or filter strip according to Conservation Practice Standard Code 393 - Filter Strip. Surface soil will be salvaged and spread over critical areas or constructed areas of the waterway or disposal area.

Erosion control practices will be required in concentrated flow areas in cropped fields. Where large permanent type drainage depressions on large concentrated flow areas exist, they will be designed, shaped, and established as grassed waterways. Smaller concentrated flow areas that will continue to erode will be smoothed and established to adapted perennial grasses and/or legumes. The maximum drainage area that can be smoothed and established to vegetation without a site specific design shall be as follows:

Hydrologic Soil Unit	Maximum Drainage Area (Acres)
A	5
B	4
C	3
D	2

The treated width will be sufficient to cover the concentrated flow scour area plus a minimum of 6 (1.8m) feet on each side of the scour area. The recommended width may be adjusted upward for even round trips for the mowing (maintenance) equipment. Vegetative treatment will be applied according to Conservation Practice Standard Code 342 - Critical Area Treatment. Record the length, width, and area as documentation on the plan map or in the engineering field notes with the vegetated waterways and field borders.

Width

The bottom width of trapezoidal waterways or outlets shall not exceed 100 (30.5 m) feet unless multiple or divided waterways or other means are provided to prevent meandering of low flows. The minimum width shall be that necessary to carry the designed capacity either at or below designed depth. Waterways and disposal areas which will be crossed by farm equipment should have a minimum top width of 40 (12.2 m) feet where crossed. Exceptions to this requirement for small capacity waterways with crossable side slopes can be granted by the field engineer.

Side Slopes

Shaped and constructed waterways shall have minimum side slopes of 8:1. The minimum side slope will be 4:1 in pastures. Side slopes on other waterways shall not be steeper than 2:1. See "Shape" above for recommended treatment of small concentrated flow areas.

Depth

The minimum depth of a waterway that receives water from terraces, diversions, or other tributary channels shall be that required to keep the design water surface elevation at, or below, the design water surface elevation in the terrace, diversion, or other tributary channel at their junction when both are flowing at design depth.

Drainage

Subsurface drains, underground outlets, stone center waterways, or other suitable measures shall be provided for in the design for sites having prolonged flows, a high water table, or seepage problems. See Conservation Practice Standards Code 606 - Subsurface Drains and Code 620 - Underground Outlets. Water-tolerant vegetation may be an alternative on some wet sites.

Outlets

All grassed waterways shall have a stable outlet with adequate capacity to prevent ponding or flooding damages. The outlet can be another vegetated channel, an earthen ditch, a grade-stabilization structure, filter strip, or other suitable outlet.

Waterways may outlet in crop fields when it is not practical to construct the outlet across the flat part of the field. A non-vegetated shallow channel should be constructed across the crop field. The following criteria will be met:

1. The outlet would be stable and would not create undue scour or land degradation.
2. The grade of the waterway is less than 0.5% and deposition is occurring.
3. The occasional loss of crops is acceptable to the farmer when large rainfall events occur.

The release of water in crops is not recommended but may be done under the above restrictions.

Disposal Areas

Disposal areas should be used where the volume of runoff makes it impractical to construct a waterway or where the slope of the land is too steep to concentrate the flow in such a waterway. Disposal areas should be slightly larger than a waterway of comparable drainage area. The first terrace will outlet onto the upper edge of the disposal area; the disposal area will then widen as it goes down the slope.

CONSIDERATIONS

Important wildlife habitat, such as woody cover or wetlands, should be avoided or protected if possible when siting the grassed waterway. If trees and shrubs are incorporated, they should be retained or planted in the periphery of grassed waterways so they do not interfere with hydraulic functions. Mid- or tall bunch grasses and perennial forbs may also be planted along waterway margins to improve wildlife habitat. Waterways with these wildlife features are more beneficial when connecting other habitat types; e.g., riparian areas, wooded tracts, and wetlands.

Water-tolerant vegetation may be an alternative on some wet sites.

The most critical time in successfully installing grassed waterways is when vegetation is being established. Special protection such as mulch anchoring, nurse crop, straw or hay bale dikes, filter fences or other diversion methods are warranted at this critical period. Supplemental irrigation may also be warranted. The vegetation should be well established before large flows are permitted in the channel.

Proper planning, design, and layout of grassed waterways is essential to enable erosion control vegetation to be established, used, and maintained. Good vegetation will reduce surface runoff and increase infiltration and percolation into the ground water. Grassed waterways are essential as outlets for open flow terraces, diversions, contour buffer strips, water and sediment control basins, and contour farming. A well established waterway can trap sediment, reduce nutrients and pesticides from

leaving the land and use plant nutrients that move onto the waterway.

Many soils either do not need or are not well suited for a water management system. Reference will be made to soil interpretations (blue sheets) in Section II of the Technical Guide to determine those features that affect the construction function or might cause problems after construction. Some fields are not well suited to a system because they are too sandy, stony, shallow, or steep. Good judgment should be used in evaluating the suitability for a water management system on fields with these soil features. Terraces, diversions, grassed waterways, or disposal areas should be installed only where field conditions facilitate stable systems.

Vegetative Establishment

Vegetative treatment will be applied in accordance with the standard for Critical Area Planting - 342 and the vegetative criteria below:

1. The area will be fenced when needed to protect the vegetation.
2. Vegetation in waterways or outlets or disposal areas shall be well established before additional drainage water from a field, terraces, diversions, or other structures is allowed to flow in the waterway except where the average slope of the waterway or outlet is 2 percent or less and the design velocity (V1) is 3.0 feet per second or less.
3. The Form ALAGRON-1, Establishing Vegetation on Critical Areas, should be prepared with a copy to the land user and conservation contractor.

Erosion and Pollution Control During Installation

Measures will be taken during design, construction, and establishment to minimize erosion and pollution. This may include details and specifications for such items as silt fence, hay bale barrier, temporary vegetation, mulching, etc.

PLANS AND SPECIFICATIONS

A vegetative plan or written recommendations for treating with vegetation will be made for each waterway or group of waterways. Vegetative treatment shall be applied as shown in specifications or plans. Vegetation includes seedbed preparation, liming, fertilizing, seeding, and either natural mulch or manufactured mulches when needed. Any job sheets, drawings, plans, or narrative statements needed should be included in the plans and specifications.

OPERATION AND MAINTENANCE

A maintenance program will be established to maintain capacity, vegetative cover, and the outlet. Vegetation damaged by farm machinery, erosion, cattle, drought, or herbicides must be repaired promptly. Such maintenance will include repairing rills and breaks in sod, removing or spreading silt deposits, or build-up at edge of waterway, fertilizing, mowing, properly preparing land, and tilling areas adjacent to the waterway or disposal area.

Plowing and/or chiseling of the land area should be varied to avoid dead furrows and buildup of ridges at the edge of the waterway. Land users will be discouraged from using waterways or outlets as farm roads. Plan, locate, and design farm roads away from the waterway or outlet channel when a road is needed in the vicinity. Grassed waterways, field borders, and filter and sod strips may be used for grazing or hay production with good management.

REFERENCES

Engineering Field Handbook, Part 650,
Chapter 7
Alabama Engineering Field (Design) Manual
SCS-TP-61
Handbook of Channel Design for Soil and Water
Conservation Practices
Conservation Practice Standards
Critical Area Planting - Code 342
Filter Strip - Code 393
Lined Waterway or Outlet - Code 468
Subsurface Drain - Code 606
Underground Outlet - Code 620

CONSTRUCTION SPECIFICATION**GRASSED WATERWAY**

(No.)

Code 412**SCOPE**

This item shall include the shaping or construction of waterways, outlets, and disposal areas, and the establishment of adapted vegetation for the safe disposal of runoff from fields, diversions, terraces, or other structures. Construction operations shall be carried out in such a manner that erosion, air, water and noise pollution will be minimized and held within legal limits as established by state or local regulations.

OBSTRUCTION REMOVAL

All brush, trees, stumps, fence rows, and other objectionable material shall be removed and disposed of in such a way that they will not interfere with constructing, shaping, or proper functioning of the waterway, disposal area or filter strip, or outlet.

CROSS SECTION

The waterway or water disposal areas shall be shaped or constructed to the specified dimensions and shall be free of bank projections, abrupt changes, and other irregularities. Concrete or rock-lined waterway sections will conform to Conservation Practice Standard Construction Specification Code 468 - Lined Waterway or Outlet.

SLOPE

Within a given reach, waterways, outlets, and disposal areas shall have a uniform, continuous slope in the direction of flow.

DISPOSAL

All earth removed and not needed in construction shall be spread or disposed of in such a way that it will not interfere with the functioning of the waterway. Care must be taken in spreading waste material so that neither ridges nor holes are formed along the sides of the waterway. Such obstructions restrict drainage from rows, terraces, diversions, or other structures. All portions of the waterway or outlet shall be finished and smoothed in such a manner that farm equipment can cross and applied vegetative cover can be properly maintained.

FILL

Fills shall be compacted as needed to prevent uneven settlement that would cause damage in the completed waterway.

POLLUTION CONTROL

Construction operations shall be carried out so that erosion and sediment control is addressed, and air and water pollution is minimized. This may include such items as silt fence, hay bale barrier, temporary vegetation, mulching, etc.

VEGETATION

Vegetation will be established as specified in the vegetative plan.